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Subject Fluid Mechanics

Submmittide to Engr. Abdul Waheed

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Q1 part A Ans

Total Energy head:

it is sum of all energy Potential head, velocity head and pressure head at a point in fluid.

$$H = Z + v^2/2g + P/w$$

Various from of Energy:

There are various from of total energy head which are.

1) kinetic head

2) Potential head

3) pressure head

1) Kinetic head:

kinetic head is kinetic energy per unit weight of Fluid is known kinetic head.

$$K.H = v^2/2g$$

2) **Potential head:**

it is The potential energy per unit weight of The Fluid.

$$\frac{P.E}{w} = \frac{mgh}{mg} = h$$

3) **Pressure head:**

The vertical height of free Surface above any point in a liquid at rest is pressure head.

OR

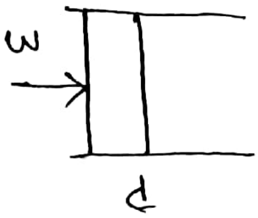
Level of Fluid due to pressure exerted by Fluid.

$$\text{Pressure head} = \frac{PE}{\text{weight}} = P/\gamma$$

OR

$$= \frac{F.d.s}{w}$$

$$= \frac{P.A.ds}{w}$$



$$= \frac{P.V}{w}$$. P/γ is pressure.

Q1 B Ans.

Hydralic Grade line:-

hydralic grade line is The Surface or profile of water flowing in an open channel or a pipe – following partially full. If a pipe is under pressure. The hydralic grade line is That level water would rise to in a small. vertical tube connected to The pipe.

Energy Line:- A line That represent the elevation of energy head (in ft or meter) of water following in a pipe, Conduit or channel the line is drawn above the Hydralic grade line (gradient) a distance equal to The velocity head ($v^2/2g$) of water following at each Section or point along The pipe.

Hydraulic radius:-

The Hydraulic radius (R_h) is The cross sectional area of The flow divided by The wetted perimeter. For a circular pipe following full, the hydraulic radius is one fourth of the diameter. For a wide rectangular channel, the hydraulic radius is approximately equal to the depth.

$$R_h = A/P$$

A = Cross Sectional Area.

P = wetted parameter.

That

Q02 ⑤

a)

$30.58 + 0.101$

$v = 2 m/sec$

$p = 300 kpa$

$= 30 \times 10^3 N/m^2$

$Z = 5m$

H = pressure Head + K.E + P.E

$H = P/\gamma + \frac{v^2}{2g} + Z$

$H = \frac{300 \times 10^3}{9810} + \frac{2}{2 \times 9.81} + 5$

$H = 30.58 + 0.101 + 5$

$H = 35.785 \ Nm/w$

Q2

B

Given Data.

Diameter $= d_1 = 300mm$

$= d_2 = 200mm$

P_1 = pressure $= 300$ kPa

$= 300 \times 10^3 N/m^2$

$P_2 = 120$ kPa $= 120 \times 10^3 N/m^2$

Datum $= Z = ?$

$Q = 40/1000 \ m^2/sec$

$d_1 = 300mm = 0.3m$

$d_2 = 200mm = 0.2m$

Required :-

$Z_2 = ?$

Solution :-

$$A_1 = \frac{\pi d_1^2}{4}$$

$$A_1 = \frac{3.14 \times (0.3)^2}{4}$$

$$A_1 = 0.0706 m^2$$

$$A_2 = \frac{3.14 \times (0.2)^2}{4}$$

$$A_2 = 0.0314 m^2$$

we known That

$Q_1 = V_1 A_1$

$V_1 = Q / A_1$

$V_1 = 0.04 / 0.0706$

$\boxed{V_1 = 0.566}$

$Q = 40/1000$

$\Rightarrow 0.04$

$V_2 = Q / A_2$

$V_2 = 0.04 / 0.0314$

$\boxed{V_2 = 1.27}$

Now

$$P_1/\gamma + \frac{V_1^2}{2g} + Z_1 = P_2/\gamma + V_2^2/2g + Z_2$$

$Z_1 = 0$, $\gamma = 9810$

$$\frac{300 \times 10^3}{9810} + \frac{0.566^2}{2(981)} + 0 = \frac{120 \times 10^3}{9810} + \frac{127^2}{2(981)} + Z_2$$

$30.59 = 12.314 + Z_2$

$\boxed{Z_2 = 18.276}$

Now eq ①

Q3

Given Data

$L = 500m$

$D = 0.2m$

$S = 0.9$

$\mu = 6\times10^{-5}\ N.S/m^2$

$Q = 0.06m^3/sec$

$f = [0.0032 + (0.221/R^{0.237})$

Req.. Pressure loss $= \Delta P = ?$

Solution:- As we know That

$$f = [0.0032 + \left(\frac{0.221}{R^{0.287}}\right)$$

where R is Renold's no and is given as.

$$R = vxd/v \quad -①$$

and $v = \frac{\mu}{g} = \frac{6\times10^{-5}}{900}$

$v = 6.67\times10^{-8}\ m^2/s$

and

$V = Q/A$ ∵ For Circular pipe

$V = \frac{0.06}{0.031}$ $A = \pi/4\ d^2$

$= \pi/4\,(0.2)^2$

$V = 1.95\ m/s$

$= A = 0.031\ m^2$

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Now eq ①

$$R = \frac{1.95 \times 0.2}{6.67 \times 10^{-5}} = 5.73 \times 10^{6}$$

Now $f = 0.0032 + \frac{0.221}{(5.73 \times 10^{6})^{0.237}}$

$$f = 8.79 \times 10^{-3}$$

or $f = 0.00879$

Now for bernoul's equation

Head loss $= h_L = \frac{f L v^2}{2gD}$ —— (11)

putting value in eq ①

$$h_L = \frac{(0.00879)(500)(1.95)^2}{2(9.81)(0.2)}$$

$$h_L = 4.259 m$$

Now to find pressure due to friction Pressure Head formula is used.

$$h_L = \Delta P / \rho g$$

$$\Delta p = h_L \times \rho g$$

put value

$$\Delta p = 4.259 \times 900 \times 9.81$$

$$\Delta p = 37602.7 \text{ pa.}$$

$$\boxed{\Delta p = 37.602 \text{ kpa}}$$